

**IN THE DRAWINGS**

A substitute set of drawings are submitted herewith to overcome the objections to the drawings set forth in Paragraph 3 of the Office Action.

## **REMARKS**

The new claim set will greatly facilitate prosecution of the application in that they more patentably define and distinctly claim the present invention.

Original claim 1 was rejected as anticipated by Birkenmaier '962. It is respectfully submitted that new claims 31 through 55 patentably define over the cited reference.

Claim 31 calls for the pressure roller to have an inner layer of a deformable flexible material attached completely around the circumference of the pressure roller such that there is essentially no relative movement between the inner layer and pressure roller in operation of the drafting device. As explained in the specification, the inner layer compresses and deforms at the point of contact with the opposing cylinder so that a planar clamping surface is defined with the fibers conveyed between the rollers. Claim 31 further calls for an outer circumferential layer of a generally inelastic material to be disposed around at least a portion of the outer circumference of the inner layer, the outer layer being thinner than the inner layer and disposed around the inner layer so as to slide relative to said inner layer upon rotation of the pressure roller in operation of said drafting device. As explained in the specification, the outer layer flexibly adapts to deformation of the inner layer while substantially eliminating tension forces between the fibers and pressure roller, resulting in improved drafting. This unique combination is not disclosed in the arrangement of Birkenmaier '962.

The roller in Birkenmaier '962 is formed by the mirror image parts 11, 12 having axial projections 15, 16 that abut to define a channel. The only layer that can be considered as the "outer" layer in Birkenmaier '962 is the belt 20 that contacts the fibers in operation of the device. Thus, the inner layer would be sleeve 17. However, this

sleeve is not disposed completely around the projections 15, 16 so that there is no relative movement between the sleeve and the projections. In fact, a gap 18 is defined between the sleeve 17 and the projections. Also, the sleeve is not described as a deformable, flexible material. In fact, Birkenmaier '962 teaches away from the use of such a layer. At col. 2, lines 12 to 18, the reference teaches that the pressing force of the roller is slight so that fiber transport is conducted without fiber breakage. With the invention of the present claims, the pressure roller has a relatively high pressing force to achieve a good drafting effect. Therefore, the inner layer is soft and produces tension in the fibers by deformation. The outer layer adapts to deformation of the inner layer to substantially reduce tension forces between the fibers and roller.

Even if the projections 15, 16 of Birkenmaier '962 were considered as an "inner layer" over another roller structure (which is not suggested by reference) the projections 15, 16 are not a layer of deformable flexible material, and the adjacent layer (sleeve 17) cannot constitute the "outer layer." Belt 20 is separate from the sleeve with a gap defined between the components.


Accordingly, it is respectfully submitted that the device of Birkenmaier '962 is fundamentally different from the combination of claim 31.

Claim 46 is drawn to the outer layer component used in the combination of claim 31 and distinguishes over Birkenmaier '962 for the reasons discussed above.

Applicant respectfully submits that the claims are allowable over the art of record, and favorable action thereon is respectfully requested. The Examiner is encouraged to contact the undersigned at his convenience should he have any questions or require any additional information.

Respectfully submitted,

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**PATENT APPLICATION**

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**TITLE OF THE INVENTION**

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COVERING FOR DRAFTING ROLLERS

**FIELD OF THE INVENTION**

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The invention relates to a roller drafting device for spinning machines in which the covering for the pressure rollers consists of an outer and an inner layer and the outer layer has a thinner wall than the inner layer, as well as to a belt or casing for use as a covering for pressure rollers in such drafting devices for spinning machines in which the thinner-walled outer layer loosely surrounds the thicker inner layer so that the outer layer can move relatively to the inner layer.

**BACKGROUND**

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During the drafting of fiber bands in drafting devices, the clamping action of the roller pairs plays a decisive part for the transfer of the drafting forces onto the fiber band. The roller pairs of the drafting device therefore consist of a fluted steel cylinder, the so-called lower cylinder, and of a pressure roller, the so-called upper roller, that is pressed by load onto the steel cylinder. As a rule, this pressure roller comprises an elastic covering so that no clamping line is produced but rather a clamping surface formed by the deformation of the elastic covering, which surface brings about a significantly better fiber retention. A good clamping action is exerted on the fiber structure without damaging the fibers. Experience has shown that soft roller coverings therefore yield better drafting results since the softer the covering is, the greater is the clamping surface. However, soft roller coverings have the

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disadvantage that they wear down very rapidly and that grooves are produced in particular in the area of the fiber passage. This so-called "shrinking" is eliminated by buffing over the entire covering surface. This alters the geometry of the drafting device rollers and therewith also the covering properties, which for its part has a disadvantageous effect on the drafting conditions and thus on the yarn values. In addition, the regrinding of the roller coverings is a quite expensive measure.

The attempt has therefore already been made to counteract this disadvantage by means of a multi-layer roller covering. DE 1 815 739 U teaches a pressure roller whose elastic jacket is subdivided into at least two layers of which the outer layer is designed as an elastic casing consisting of a thin hose that can be drawn over the elastic jacket of the pressure cylinder. The designing of the outer layer as a hose makes it easy to draw a cover over the elastic jacket and also to easily remove it from the latter when this outer circumferential surface has become worn. The fixing of the elastic hose is ensured by the natural friction between rubber and rubber. This known design does make it possible to readily replace the elastic outer layer; however, it was not able to solve the problem of the rapid wear and of the shrinking.

DE 1 685 634 A1 teaches a covering for drafting device rollers of spinning machines which covering is composed of two superposed cylindrical layers of which the outer layer is harder and has a thinner wall than the inner layer. The two layers are adhered to one another. As a result thereof, very different materials can be combined with each other in order to avoid the formation of windings and electrostatic charging. However, it turned out that the problem of a good drafting

ability and of wear were not satisfactorily solved. In addition, as a consequence of the adhesion the changing of the outer layer is expensive.

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### SUMMARY

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The invention has the problem of eliminating these disadvantages and of finding a roller covering that has high wear resistance and long-lasting elasticity in the running layer and thus ensures optimal drafting conditions for a long time. Additional objects and advantages of the invention will be set forth in part in the following description, or may be obvious from the description, or may be learned through practice of the invention.

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It surprisingly turned out that it is important in a multi-layer covering with a thin outer layer and a thicker inner layer that a relative movement can take place between the two layers. The milling motion of the soft covering and the tension forces produced thereby are then transferred only onto the inside of the outer, thin-walled layer but not on the fibers and the fluted cylinder. Practically no wear occurs any more, in particular no groove formation (shrinking), so that the outer layer has a service life that is more than three times longer than certain prior devices discussed above.

The outer layer is advantageously adapted on its outside as a fiber contact surface to the requirements of a good fiber clamping and on its inside as a running surface to the smoothest possible, low-friction running of the pressure roller. This is achieved, e.g., in a simple manner by the selection of appropriate material compositions for the fiber contact layer and the running layer of the outer layer. This

outer layer can be designed as the casing around the inner pressure roller layer as well as an endless belt. It must only be so flexible that it adapts to the deformation of the soft inner layer. It proved to be especially advantageous to design the outer layer in the direction of travel of the fiber structure, that is, transversely to the roller axis, as inelastically as possible, that is, ~~with the lowest possible extensibility~~. The tension forces in the clamping surface producing wear and acting negatively on the drafting are eliminated in this manner, whereas the outer layer can adapt in the axial direction to the rugosities of the fiber structure. An excellent clamping is achieved in this manner. The desired reduction of the expansion of the outer layer transversely to the axis of the pressure roller is achieved quite well by a yarn insert without limiting the expandability in the direction of the roller axis. The relative motion between the outer layer and the inner layer is favored by the smoothest possible surface of the running layer of the outer layer, and as a consequence thereof the breakdown of the tension forces is furthered in an even better manner.

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It is advantageous for a high delivery speed to use an outer layer designed as a belt and to run this belt through a deflection rail. In addition, this deflection rail can also comprise side rims for a more reliable guidance. It also proved to be especially advantageous at high delivery speeds for a trouble-free travel if the belt rolls off the pressure roller at an angle  $\alpha > 30^\circ$  to the plane of the fiber structure. The belt advantageously consists of several layers and the inside is designed as a smooth travel layer and the outside as a fiber contact layer. A yarn insert is provided between the layers which prevents the belt from expanding in the direction of travel without adversely influencing a desired transverse expansion.



Further details of the invention are explained using the figures.

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### **BRIEF DESCRIPTION OF THE FIGURES**

Figure 1 shows the design of the two-layer roller covering in longitudinal section in accordance with the invention.

Figure 2 shows a cross section through the device according to figure 1.

Figure 3 shows the design of the outer layer as belt.

Figures 4, 5 schematically show the design of the outer layer with an insert for stiffening in the direction transverse to the cylinder axis.

Figure 6 shows in section the guidance of the belt by means of a deflection rail.

Figure 7 shows a plan view accompanying Figure 6

### **DESCRIPTION**

Reference is now made in detail to embodiments of the invention, one or more examples of which are illustrated in the drawings. Each embodiment is provided by way of explanation of the invention, and not as a limitation of the invention. For example, features illustrated or described as part of one embodiment may be used with another embodiment to yield still a further embodiment.

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In figures 1, 2 pressure roller 3 is arranged above drafting device cylinder 5 and comprises covering 2 permanently connected in a customary manner to pressure roller 3. Drafting device cylinder 5 and pressure roller 3 form the exit roller pair of a drafting device running at a high speed in accordance with the delivery.

Another coating 1 is provided as an outer layer over this inner layer coating 2 of pressure roller 3. This outer layer consists in the embodiment shown here of thin-

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walled casing 1 consisting of flexible material that behaves practically without expansion relative to the material of inner layer 2 in the direction of travel of casing 1. This casing 1 is slipped loosely over inner layer 2 of pressure roller 3 so that intermediate space 6 can form in the non-loaded area between inner and outer layers. It is essential that casing 1 can move relative to inner layer 2 of pressure roller 3. On the other hand, inner layer 2 is drawn firmly onto pressure roller 3, as is customary. Under the loading of pressure roller 3 soft inner layer 2 is pressed onto drafting device cylinder 5 and deformed, so that no linear contact with drafting device cylinder 5 takes place but rather an area or planar support takes place.

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Since outer layer 1 is thin and flexible, it adapts to the deformation of inner layer 2 without being substantially compressed itself. Therefore, in contrast to the inner layer, no appreciable pressing work is performed in the case of outer layer 1. The clamping surface generated by the deformation of inner layer 2 is transmitted by outer layer 1 so that fiber structure F (Fig. 6) provided for the drafting is clamped by this clamping surface when passing through roller pair 3, 5.

In the customary pressure roller coverings, a clamping surface is formed by the soft elastic covering which surface produces a good clamping action. However, tension forces are produced in the area of the clamping surface by the pressing work of the covering that have a negative effect on the fiber structure during drafting and also cause the known high wear of the covering. However, the arrangement of an outer layer 1 that flexibly adapts to the deformation of soft and elastic covering 2 of pressure roller 3, but that causes no or only a very low pressing work on account of its lower thickness and deformability, surprisingly led to the result that this outer

layer 1 exhibits a significantly greater stability and also the soft inner layer 2 displays none of the customary phenomena of wear and shrinking. It turned out in extensive tests that outer layer 1 still ran without any problems even after three times the run time and did not have to be replaced. The drafting values were even able to be improved compared to new traditional coverings. It is to be assumed that this surprising result can be traced to the fact that the tension forces conditioned by the pressing work of soft and elastic inner layer 2 of pressure roller 3 can not affect the clamped fiber structure. These tension forces are degraded by the relative motion that is possible between soft inner layer 2 and smooth run layer 102 (Fig. 4) of outer layer 1. No relative movement takes place between the fibers and drafting device cylinder 5 as well as outer layer 1 so that the clamping takes place in the area of static friction. Thus, no wear caused by sliding can occur.

In the exemplary embodiment according to figures 1, 2 the outer layer is designed as cylindrical casing 1. However it can also be designed as a rather long endless belt. This cylindrical casing 1 as well as a belt 10 or 100 can be readily replaced in case of wear or the formation of grooves in the area of fiber structure F. Figure 3 shows endless belt 10 that surrounds pressure roller 3 with its soft elastic inner layer 2 and is guided by deflection rail 4. The construction as a rather long endless belt 10 or 100 and its guidance by deflection rail 4 proved to be particularly advantageous when the device is run at high delivery speeds.

It should be taken into consideration that, depending on the particular draft, drafting devices 3, 5 forming the delivery roller pair run approximately 20 to 30 times more rapidly than the roller pairs arranged in front of the main drafting field, that are

customarily surrounded by fiber guide belts. These known fiber guide belts proved to be unsuitable for being used as outer layer 1 on exit roller pair 3, 5. These belts are insufficient in their properties. Thus, it turned out, e.g., that it is important that outer layer 1 or belt 10 or 100 is as inelastic as possible in the direction of travel of fiber structure F, that is, transversely to roller axis 31, so that it can not expand.

Of course, not every expansion can be eliminated in the physical sense but it should be as small as possible. This achieved in a simple manner by yarn insert 103. Furthermore, the known belts favor the sliding of the fibers during drafting, which is undesired for the exit roller pair.

Figure 4 shows the design of outer layer 1, 10 or 100 in section, that is directed specifically toward these desired properties. The outer layer designed as casing 1 or lengthened endless belt 10 or 100 is advantageously composed of several layers: Of fiber contact layer 101 and of run layer 102. Yarn insert 103 is arranged between both layers 101, 102 for eliminating the expansion in the longitudinal direction, which insert is firmly connected to fiber contact layer 101 and also to run layer 102. Fiber contact layer 101 is designed in its surface and in its material in contact with fiber structure F for receiving the retention forces necessary during drafting. This is achieved, e.g., by using a material like the one used for pressure roller coverings. On the other hand, run layer 102 is provided with a smooth surface favoring sliding, in order to make possible a relative motion relative to outer layer 100, 10 or 1 around inner layer 2. A material favoring sliding is preferably used for run layer 102 like the material used, e.g., for the known belts for fiber guidance in the main drafting field.

Yarn insert 103 takes the elasticity from belt 100 in the direction of travel so that an expansion is practically not possible. However, the expandability remains transversely to the direction of travel, that is, in the direction of pressure roller axis 31. The belt can adapt to the rugosities of drafted fiber structure F so that a good clamping is always ensured. In spite of these multi-layers of the outer layer, the latter must naturally not be too thick in order to impart good flexibility to it for adaptation to the deformation of inner layer 2 and to fiber structure F. A total thickness of 0.8 to 1.0 mm has proven to be especially advantageous in this connection as regards the stability and also the drafting results. No groove formation (shrinkage) could be determined even after several years of run time.

The desired properties of run layer 102 and a fiber contact layer 101 can also be achieved by an appropriate physical shaping of the surfaces. However, run layer 102 and fiber contact layer 101 preferably consist of different materials that have the desired sliding properties and the necessary grip. Measurements according to DIN 53375 have shown that e.g., the above-described material for fiber contact layer 101 has a frictional force value that is at least twice as high as the frictional force value of run layer 102 when the latter consists of a material like that used for belts for fiber guidance in the main drafting field. Run layer 102 thus has good sliding properties while fiber contact layer 101 achieves an excellent clamping of the fibers.

The manufacture of such an endless belt in accordance with figures 4,5 takes place, e.g., in such a manner that at first run layer 102 is applied onto a tubular body with a circumference corresponding to the length of the belt, onto which run layer a

yarn is wound that forms yarn insert 103. Then, this yarn insert 103 is covered with fiber contact layer 101.

In the embodiment according to figures 6, 7 a belt 100 is run through deflection rail 4. In order to ensure a light run of belt 100, deflection rail 4 is not only rounded but additionally provided with a low-friction coating. Cage 42 with guide rims 41 follows this deflection rail 4. The space between deflection rail 4 and drafting device roller 3 is encapsulated by this cage 42 and its guide rims 41, so that collections of fluff in this space are avoided. Belt 100 runs from drafting device roller 3 at an angle  $\alpha$  relative to the plane of fiber structure F. This avoids turbulence and fly formation in the exit area of fiber structure F. Cage 42 is supported on holding rail 44 via pressure springs 43 so that deflection rail 4 exerts a tension on belt 100. Side rims 41 serve to laterally guide belt 100. An easy and rapid replacement of belt 100 is also possible in this embodiment. Belt 100 is relieved by pressing deflection rail 4 back and can also be readily lifted over side rims 41. These side rims 41 also serve in addition to encapsulating the space between pressure roller 3 and deflection rail 4 for the lateral guiding of belt 100. If outer layer 1 of pressure roller 3 is arranged asymmetrically to fiber structure F, outer layer 1 can be turned so that the left side is located on the right side and thus fiber structure F runs over an unused surface of the outer layer.

It should be appreciated by those skilled in the art that various modifications and variations can be made to the embodiments of the invention described herein without departing from the scope and spirit of the claims or their equivalents.